ON THE PATHOLOGY, ETIOLOGY AND TREATMENT OF HIP-JOINT DISEASE IN THE LIGHT OF PRESENT BACTERIOLOGICAL AND OPERATIVE EXPERIENCE.[1]

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PATHOLOGY. Following the publication, a few years since, of the experimental researches and the deductions therefrom, made by Professor Koch, of Berlin, with reference to the introduction and development of the bacillus of tuberculosis within the human body, has come the belief that hip-joint disease is directly and absolutely the result of the changes produced in the joint tissues by the irritation and growths caused by the presence of this bacillus; therefore the name of tubercular degeneration is now used to express the manifestations incidental to the presence and progress of this affection of the hip joint. It is a disease of common occurrence, and frequently leads to very great destruction of the joint elements, often having a fatal issue.

The great variety of the manifestations of the presence of the disease in the joint is dependent upon the variety of the component elements thereof, any one of which may furnish the primary focus of its onset. Hence there has been a corresponding diversity of opinion as to the tissue in which the disease exists primarily, some surgeons asserting that its frequency of commencement is first in the synovial membrane; others in the capsule; others in the ligamentum teres; and still others, constituting the largest majority, contend that its primary manifestation is in the development of a tubercular ostitis in the head of the femur or the cancellated bone tissue at the bottom of the

[1]This lecture was deliverd by the late Professor Parkes before his class at Rush Medical College in October, 1890, six months before his death.

acetabular cavity; the same principle holding true here as elsewhere in the predominance of epiphysial affection. The examination of a large number of specimens after resection of the hip joint favors the supposition that an ostitis, resulting from the implantation and development of the bacillus tuberculosis in the cancellous tissues of the bony elements of the joint, is the starting point of this disease most frequently by far, in children at least. In adults the synovial membrane of the joint is often the first tissue to be affected, leading to distinct and regular changes, such as thickening, loss of function and tissue degeneration. Thickening, from infiltration, cell proliferation and tubercular growths; loss of function, in painful and limited motion and hyper-secretion with over distension of the joint and consequent loss of its normal landmarks; tissue degeneration, showing formation of granulations and fungus outgrowths on the internal surface of the synovial membrane and interference with local circulation, marked by whiteness of the skin covering the joint and the arborescent ramification of dilated superficial veins.

The changes in the tissues, when ostitis marks the onset of the disease, are exactly similar to those occurring in inflammation of bone from any source. These will be hyperemia, rarefication of bone spaces, absorption of calcareous matter, softening, liquefaction; and added to these there will be the formation of a cheesy deposit, tubercles and granulation tissue. Such changes cannot occur without absolute interruption of circulation in the blood vessels of the bone itself over greater or less areas, leading to destruction of bone in small particles, termed caries, or in larger masses, termed necrosis. If necrosis results in consequence of this cutting off of the arterial supply the peculiar distribution of the arteries of the bone near their extremities quite frequently leads to the production of a triangular or cone-shaped fragment of dead bone, the base of which is directed towards the joint surface. The extent of the caries or necrosis will depend upon the degree of development of the bacilli and the changes they produce after infection, and the consequent amount of interference with the vascular supply of the bone concerned in the disease.

Such changes as we have indicated cannot occur without leading to well-marked evidences of interference with the nutrition of many tissues in the immediate neighborhood of the disease process. The cartilages of joints are dependent entirely for their nourishment upon the looped arrangement of blood vessels in the bone tissue immediately beneath them and to which they are attached; hence very soon, accompanying the bone changes, the cartilage covering the head of the femur or lining the bottom of the acetabular cavity is deprived of its nutrition, is separated from its bony attachments by the growth of granulations beneath it, and becomes necrotic; its surface, perforated here and there by the pressure of subjacent granulations, finally is loosened entirely or broken into many fragments, and its debris will be found floating in the fluid discovered in the joint when it is opened. Its condition of partial or complete destruction depends entirely upon the degree and severity of the disease or the length of time this disease has been in progress.

If the infection includes or progresses so as to attack the synovial membrane, this membrane is doubled and more in thickness; its polished surface is destroyed, and in lieu thereof is found a covering of soft, velvety granulations, sometimes present in such abundance as to constitute real fungosities. Their integrity is easily destroyed and the destruction is accompanied with profuse bleeding, a condition called by older writers fungous degeneration of joints.

Again, this synovial tissue may be necrotic in many places, rough, irregular upon the surface and dirty in appearance, according as the progression of the disease has led to greater or less disturbance of its vascular supply, and hence of its nutrition. This amount of disturbance varies from a condition which leads only to a constant over-distension of the joint with serum, either natural in color or slightly bloody, with or without flakes of lymph floating in the fluid, or to one which causes an accumulation of turbid fluid filled with the products of destructive action upon the granulations or the joint tissues. If pus infection is added to the disease already present the capsule may be filled with pus as well.

The distension of the joint with fluids quite frequently leads to rupture of the capsule at its weakest points and dissemination of its contents into surounding parts; hence the tubercular abscesses which approach the surface gradually, showing fluctuation and pressure changes of the skin covering them, and indicating the necessity for incision.

The head of the femur presents much diversity of form as the result of the changes produced in it by the ravages of the disease; it is apt to be much softened and its substance more or less destroyed by liquefaction and absorption of its tissue, so that many times nothing but a short portion of the neck remains continuous with the shaft. If the onset of the disease be close to the epiphysial junction of the shaft, the epiphysis is not infrequently destroyed at once, is separated from all its attachments and is discharged or removed entire as a necrosed fragment.

Pathological changes similar to those already mentioned occur in the joint as the result of the commencement of the disease anywhere in the bony walls of the acetabulum; when commencing there the disease is not infrequently accompanied with a perforation of the acetabular cavity towards the pelvis, with the formation of abscesses bulging into the pelvic cavity.

The direction which the contents of the distended capsule take after its rupture is entirely accidental, and depends upon the site of the rupture in the capsule and the arrangement of the layers of fascia covering the joint and investing the soft parts into which it ruptures. Sometimes it projects upwards and forwards towards Poupart's ligament, and the fluctuating swelling there formed opens spontaneously or by incision above or below that ligament. In the latter case, usually indicating acetabular disease. Again, the pointing may be downwards and inwards at the apex of Scarpa's triangle, or outwards at the edge of the tensor vagina femoris muscle, or backwards upon the posterior surface of the thigh. I have on two occasions opened abscesses originating from hip-joint disease which showed the indications of pointing only when they reached the external condyle of the femur.

When the operation for excision of the joint is done early in the progress of the disease the pathological changes in the

joint surfaces themselves may be so slight as to be scarcely recognizable, yet a longitudinal section of the fragment removed often shows the foci of tubercular degeneration in spots of cheesy matter, also the formation of tubercles and granulation tissue with corresponding bone destruction.

A large accumulation of fluid filled with the detritus resulting from this disease may approach the surface in its progress, may be incised and its evacuated contents have much the appearance of the pus accumulation in ordinary abscesses, although noticeably white in color and cheese-like in character; yet cultures made from this fluid will fail to produce any of the different pus microbes. Still, you must remember that in the progress of this disease pus infection is particularly apt to occur with well-marked increase in the inflammatory symptoms attending the disease.

ETIOLOGY. The causes of the disease are, first, predisposing; second, exciting. *a*: Predisposing—heredity: A very large number of these cases furnish a history of tubercular disease in several members of the patient's immediate or remote family, so that there can be scarcely any doubt but what the special vital power which the patient receives from his progenitors has a certain influence on its occurrence. Yet it must be remembered that he who is compelled to associate with individuals already suffering from some manifestation of tubercular disease is in great danger of infection. This peculiar disposition to the occurrence of manifestations of this special disease in members of the same family is said to depend on the "tubercular diathesis." This, to me, means only that it occurs most frequently in the weakest and most debilitated individuals, hence in those least likely to resist any hurtful influence with which they may be surrounded, and who, above all, are unable to prevent the development of and the ravages incident to the presence of the bacillus of tuberculosis when once it gains entrance into the circulation and secures lodgment in the tissues of the body.

It has been proven that almost without exception the tissues found in chronic arthritis in any of the joints of the body, when subjected to microscopical research reveal the presence of this bacillus, and that these tissues upon being introduced into the body of a healthy animal lead to manifestations of tuberculosis.

The bacillus taken from the tissues of such a joint, can be grown into colonies if furnished with the proper culture medium, and when injected into the tissues of a healthy animal they will produce a like disease, so that we are bound to believe that there is a direct relation between the cause and effect—the cause being the presence of this bacillus, the effect being the manifestations of changes in the structure of the joint tissues.

Exciting cause. Trauma: Many facts seem to support the assertion that the bacilli, always found present when the disease is in a state of activity, remain latent in the system until their development is induced by the occurrence of any trauma sufficient to disturb the nutrition of the part in which the disease is to be developed, this disturbance of nutrition seemingly establishing all the conditions necessary to rapid growth of the bacilli and the development of the many changes in tissues incidental to their presence.

The hip joint and the spinal column constitute parts of the body very likely to be the seat of trauma resulting from the incessant activity and slight local injuries so often occurring in children, hence the great frequency with which the disease is found located in these portions of the body and in early life.

The diagnosis of the affection is based upon the well marked symptoms which outline its course. The consideration of these symptoms should always be preceded by careful and minute inquiry into the patient's family history. This inquiry not only furnishes the attendant with a fair estimate of the patient's vitality, but also the probable source of the infection.

Familiarity with and an acute perception of the earliest symptoms indicating the disease places the patient under the charge of the surgeon at a time when the adoption of remedial agents will often enable him to stay entirely the progress of the disease, or to control its ravages, to the extent of securing for the patient relief with only limited disarrangement of function of the joint; whereas, if left to progress to its later stages of advancement, relief, whatever the treatment adopted, must be somewhat problematic.

Symptoms.—*Lameness:* Among the first symptoms to appear is lameness, beginning with a scarcely perceptible limp, perhaps not even noticeable while the child is at play, progressing

insidiously as the disease advances, to become a constant and uncontrollable condition. Early in the disease the lameness is most noticeable when the limb is first used after a night's rest, or when it has become slightly stiffened after rest, following constant use during the day. The cause of this lameness is in part the inherent tenderness of the inflamed tissue; but it is oftenest caused by the weight of the body bringing the surfaces of the joint in contact or by making pressure upon the inflamed areas of bone beneath the joint surfaces.

Pain: During the later stages of the disease the exquisitely sensitive joint surfaces cause the slightest movements in the joint or the support of any weight to be extremely painful. The patient involuntarily, from the very commencement of the disease, puts all of the joints of the affected extremity in a state of slight flexion in order to lessen shock of any kind transmitted through the extremity to the joint; hence he flexes the ankle, the knee and the hip; and however slight this flexion may be, if it is maintained, a limp will be the result in any attempts at walking. The greater degree of flexion the more marked the lameness, and hence this symptom becomes a valuable index to the extent of the disease.

The amount of pain complained of varies greatly in different cases. Where present from the first it is an indication that the nature of the trouble in the joint should be carefully inquired into. Yet there are many cases remarkably free from this symptom; absence of pain does not, therefore, by any means always indicate the absence of the disease. A large majority of cases at first, and sometimes throughout the entire course of the disease, refer the pain to some portion of the knee joint, especially the inner side.

When a patient suffering from the lameness already described complains of pain persistent or interrupted, referred to the inner side of the knee, suspicion is always awakened as to the likelihood of this pain in the knee being dependent upon disease in the hip joint, and induces an especially careful examination of the case. This pain is supposed to be reflex in nature and dependent upon the fact that the hip and knee joints receive their articular branches from the same nerve trunk, and the irritation

of the nerve ends distributed to the hip joint is reflected to those of the knee.

A very noticeable attendant of hip disease is the special pain termed "startling pains" or "night pains," so called by being accompanied with the sudden contractions of the muscles of the limb and the body in general, startling in the suddenness, and from the fact that they are especially apt to occur at night after the child has fallen asleep. The startling pain indicates that the disease in the joint has reached an advanced stage; has progressed at least to the point of the formation of granulations, which are exceedingly tender and sensitive. During waking hours the fixation of muscular contraction prevents movement of the joint, avoiding pressure upon these granulations but as soon as sleep relaxes these contracted muscles the joint surfaces fall together, awakening the patient by the excruciating pain produced; the patient moans and cries out with a sudden starting of the entire body; the muscles are forced into sudden contraction, and the patient again falls asleep. These symptoms recur from time to time until the disease has progressed so far that the destructive changes themselves prevent the pressure which produces the pain.

Fixation: Another symptom marking the presence of the disease is fixation of the joint in some abnormal position by the contraction of the muscles of the joint. This contraction of muscles in confirmed cases not unfrequently becomes contracture, with actual shortening of the muscles, and hence permanent fixation of the limb in positions of deformity. The fixation is supposed to be dependent upon reflex stimulation of the groups of muscles concerned in its production.

Many cases are accompanied with severe pain upon the slightest movement of or jar to the affected limb. The patient's attention is constantly directed to the protection of the joint from disturbance of any kind on account of the suffering caused thereby. The position of the limb is never changed without the foot of the diseased extremity being supported by the foot of the sound limb. Again, some of these patients seem to have learned that slight extension of the diseased extremity is of service in relieving the pain, and, of their own accord, they attempt to

accomplish this result by pressure in the direction of extension made by the sound foot against that of the diseased limb.

Deformity: The deformity first present is that of flexion, adduction and external rotation. The depression of the pelvis which accompanies this change in position of the thigh is necessary in order to bring the limbs parallel with each other during walking; it produces also an apparent lengthening of the limb.

Later in the disease the deformity present is that of flexion, adduction and internal rotation. In order to make the limbs parallel after the occurrence of this deformity the pelvis is elevated, and as a consequence there is an apparent shortening of the injured limb. This apparent lengthening and shortening of the extremity is accompanied with a corresponding depression or elevation of the anterior superior spinous process of the ilium on the diseased side, caused by means of a tilting of the pubis to one side or the other.

The lengthening is always apparent, the shortening may be either apparent or real. It is always real, although at times moderate in amount, after the destructive processes of the disease have led to a rupture of the *ligamentum teres* and partial displacement of the head of the femur from the acetabular cavity. When this ligament is destroyed the powerfully contracting muscles force the head of the bone against the upper and outer portion of the brim of the acetabulum and against the corresponding part of the capsular ligament, leading to pressure changes and necrosis at these points.

The shortening is real and extreme in cases in which the pressure against the capsular ligament destroys it and allows the head of the bone to be entirely dislocated from the acetabulum. Such extreme cases are not of frequent occurrence, but they do happen. In the case of a little boy operated upon by me not long ago, the disease had been exceptionally rapid in its progress and the deformity was extreme. Incision in that case showed that there was not only absolute dislocation of the joint, but also that the formation of a new acetabular cavity had commenced about the head in its abnormal position. The shortening is real also in all cases in which

there has been absolute destruction, softening and absorption of any considerable portion of the head of the bone.

As the limb is fixed in a position of flexion of a greater or less degree, when the knees are equally extended the thigh of the diseased side carries the pelvis forward, producing a noticeable flexion forward of the lumbar vertebræ, termed *lordosis.* This condition is found as a symptom of other diseases, such as Pott's disease, infantile paralysis or congenital dislocation of the hip joint, and hence needs careful inquiry to establish the real cause of its presence.

Muscular Wasting: Cases of hip joint disease seldom fail to present, in some period of their progress, the symptom of muscular atrophy, or wasting. This is, of course, partly dependent upon their want of use, yet is so extreme in degree or marked in its results that it must have other causes for its occurrence; among these is the existence of absolute atrophic changes in the muscular fibres, probably incidental to trophic disturbances resulting from nerve irritation; it leads to loss of contour in the joint and obliteration of landmarks; the gluteal muscles become flattened, the inter-gluteal fold changed in direction, and the muscles themselves become flabby.

The shortened and contracted muscles about the joint resist any motion therein, and stand out under the skin as rigid cords upon any attempt being made to change the position of the limb, any such attempt being accompanied with extreme suffering on the part of the patient.

Swelling: In the later stages of the disease swelling occasionally becomes a symptom for consideration; the deformity thereby induced being dependent on the accumulation of fluids upon one or another aspect of the joint, following the progress of destructive changes in the joint itself, and marking the site of the accumulation with resulting abscesses. Not infrequently these cases are accompanied with enlargement of the lymphatic glands on the anterior aspect of the joint.

General Debility: Cases of hip joint disease seldom progress far without displaying well marked manifestations of debility and loss of general health; the countenance carries ineffaceable evidence of suffering, and soon shows, by its pallor and by wasting of the general body, unmistakable symptoms of

faulty or insufficient assimilative powers. The appetite becomes capricious, may fail entirely, and in extreme cases is followed by great emaciation throughout the body. The entire extremity of the side diseased is much smaller than the healthy one, and the contrast is very evident upon comparison.

COMPLICATIONS.—*Abscesses:* Formation of abscesses is of frequent occurrence, as a complication of hip-joint disease, and when the attack is sudden, always indicates infection with the pus microbe as an addition to the disease already present. Their onset is accompanied with great increase of the signs of inflammatory action, as shown by high temperature, increased pain and tenderness, chills and sweats.

Reference is not here made to accumulation of purely tubercular matter and debris which may exist in considerable size without any of these symptoms, as is shown in similar accumulations occurring in different parts of the body, termed "cold abscesses."

The occurrence of the symptoms mentioned as indicating the development of acute abscesses is soon followed by fluctuation in the swelling produced, necessitating incision for the purpose of giving exit to the pus, or if left to itself it will open spontaneously and the pus be discharged. In either case after the contents are emptied, the opening remains patulous and shows little disposition to heal, although the walls of the abscess may fall together, and its cavity so far diminish in size as to leave only a long tortuous tract, termed a "sinus." The sinus will be kept open and give exit to a persistent discharge of matter in greater or less amount, because of the presence of the dead bone or other necrotic tissue in the diseased joint.

In old cases of hip-joint disease it is not unusual to find a number of minute openings discharging pus on different aspects of the limb and widely removed from the joint.

General Tuberculosis: A very serious and fatal complication of hip-joint disease is the occurrence of meningitis, or general tuberculosis. These complications not unfrequently are developed immediately after an operation, such as excision for the relief of the disease; the operation seemingly introducing the bacilli into the general circulation, thus acting as a direct

cause for the metastasis in the meninges or other internal organs if the body.

Amyloid Degeneration: Cases in which the suppurative process has been extreme or prolonged over many months, or even years, are sometimes accompanied with an amyloid degeneration of the liver and kidneys. The following case of a little girl ten years old, admirably illustrates this condition. She had suffered for several years from prolonged suppuration following tubercular degeneration of the lumbar vertebrae and right hip joint, with almost numberless sinuses traversing both sides of the body. The enlargement of the liver was so great in this case as to fill nearly the upper half of the abdominal cavity, its lower edge reaching quite to the umbilicus; the deformity produced was very remarkable and extensive. The liver in these cases usually returns to its normal condition, if by any course of treatment the suppuration can be caused to cease entirely. It is not a condition which militates against operative interference.

Ankylosis: Usually the fixation in disease of the hip depends only upon muscular contraction and contracture, and hence constitutes a false ankylosis, which disappears partially or completely during anæsthesia.

In many cases of prolonged existence of the disease, the head of the femur and the acetabular cavity are immovably joined together by the development of bone, forming a true ankylosis. In such cases the femur and the os innominatum move as one piece of the skeleton, and the deformity present cannot be changed in the slightest degree, even under anæsthesia without the application of force sufficient to break the bone or the performance of an osteotomy.

Both hip joints are occasionally the seat of tubercular disease at the same time or within short periods. The condition of the patient under such circumstances is truly lamentable; to walk is quite impossible even early in the manifestations of the disease, and even though treatment has stayed its progress, or quieted entirely these manifestations, the resulting deformity very often makes the act of walking a great labor. A case in point is that of a young man twenty years of age, who, when eleven

years of age became afflicted with double hip-joint disease. Both hips became ankylosed in a position slightly beyond a right-angle, and the legs crossed so that one knee was in front of the other. Locomotion was possible by throwing first one hip forward, which act carried the corresponding leg to the front; as soon as the weight of the body was on this foot the other hip was swung forward, and by this alternating, half-rotary, motion he succeeded in walking short distances. In this case an osteotomy was made on both extremities at the same time, cutting through the bone with a chisel just below the trochanter major. As soon as the bone was severed the limbs were easily extended and placed in a position of adduction and external rotation; they were kept in this position by the use of Buck's extension, and at the end of eight weeks the fractures were firmly united and his previous deformity was overcome. This case was one of old hip-joint disease, hence the deformity was flexion, adduction and internal rotation. To overcome the malposition it was required to make extreme extension, adduction and external rotation. Notwithstanding the fact that the disease had existed so long, muscular contraction offered no resistance to complete extension, not a single tendon required division, but the skin immediately over the anterior surface of the joint cracked in several places under the tension to which it was subjected.

EXAMINATION OF THE PATIENT: In order that a satisfactory examination shall be made, it is absolutely necessary in all cases to remove all of the patient's clothing; especially is this desirable to enable the surgeon to detect the earliest manifestations of the disease. It is scarcely necessary to claim that the earlier the disease is detected and the more promptly remedial agencies are adopted the sooner and the more certainly will relief be given to any case coming under inspection.

The minutest alteration of the joint or limb in position or contour, or in its movements, should attract attention and be made the subject of careful and exhaustive inquiry as to their cause and meaning. The absolute confidence of the patient should be secured by every means possible before and during the progress of the examination. Above all things, gentleness in examining is especially desirable. If possible avoid all movements which are likely to give rise to pain. If movements must be made likely

to induce pain the patient should be notified of that fact, so that the patient's fortitude may be aroused to bear it. By care in these matters even the youngest of patients can be subjected to a thorough examination at least sufficiently satisfactory to elicit the presence or absence of the well-known symptoms which accompany the disease.

It is necessary that the limb, in doubtful cases, should be carried through all the motions possible in the joint and to their extreme limits, and also that each motion should be compared with the corresponding one of the sound limb. In the early manifestations of the disease it is only when approaching the extreme limit of any motion under trial that the halt or evidence of partial fixation or pain will be elicited. In cases in which the disease is more advanced the changes in contour, in loss of freedom of motion and pain will be easily determined, and do not require any roughness of handling to demonstrate their existence.

The patient should always be placed on the back on a perfectly even and smooth table, with the spine held close in contact with the table. First, try whether or not the popliteal space of each limb can be brought in contact with the table without producing any curvature or lordosis of the lumbar region of the spine; if this can be done no deformity of flexion has taken place. If the deformity of flexion has commenced as soon as the popliteal space of the injured limb is brought in contact with the table there will be produced a curvature forwards of the lumbar region of the spine, because the fixation of the femur in the position of flexion compels the os innominatum to tilt forward. By relieving the pressure from the knee and allowing the back to again touch the table, the thigh will again be flexed and give the exact angle of fixation.

In the trial of all these motions the anterior superior spinous process of the ilium should be observed to ascertain whether it remains motionless during any of the movements to which the joint is subjected; it should not be influenced in the least. If motion is communicated to it during any of the trials it indicates that there is limitation from some cause or other to the special movement under inquiry. In this careful way compare adduction, abduction and rotation in the sound and diseased extremities.

In all cases in which this disease has made considerable advance the amount, extent and kind of deformity should be carefully estimated, for it is only by an accurate knowledge of each of these conditions and of the causes which produce them that one can hope to put into practice the proper remedial procedures necessary for their relief.

PROGNOSIS. The length of time the disease has been in existence, the amount of deformity already present, the general condition of the patient, the occurrence of suppuration are all items to carefully consider before prognosis is given; the degree of severity manifested in either or all of these conditions adds greatly to its gravity. To promise a complete cure is ever unwise, no matter how early the disease is recognized or subjected to treatment; every case is followed by some degree of deformity or debility in the joint. It should always be remembered that in cases in which treatment has been followed by seemingly perfect results, foci of tuberculosis may still remain latent in or about the joint tissues, likely to be stimulated to fresh activity by any trauma sufficient to disturb the circulation in their neighborhood; indeed this relighting of the disease not infrequently happens after cases in which complete excision has apparently relieved all sources of trouble.

DIFFERENTIAL DIAGNOSIS. Affections simulating hip-joint disease are not of infrequent occurrence. Among them may be mentioned superficial abscesses in any of the tissues surrounding the hip-joint. The acuteness of their onset and rapidity of progress will usually furnish valuable items leading to their recognition. Like all tubercular affections, hip-joint disease is comparatively slow in its manifestations.

Abscess under the iliac muscle gives rise to flexion and partial fixation of the joint. Psoas abscess has its previous history of spinal fixation and deformity. Pure synovitis from traumatism has a much shorter history for its development as a distinguishing peculiarity. An almost insurmountable difficulty is offered in cases of osteomyelitis affecting the epiphysis of the upper end of the femur, and the only special symptom belonging to this affection that is at all distinguishing is the remarkable suddenness of the onset of an attack of osteomyelitis with its accompanying rapid inflammatory changes.

TREATMENT—*Natural Cure.* Like all other diseases in the human body, hip-joint disease shows a tendency to limitation in its progress by the natural powers of the system. When this occurs it follows usually as the result of the suppurative process with the formation of abscesses, ulceration of their coverings, elimination of their contents and the discharge of the necrotic bone. If the destructive action of the disease is not extensive this result is accomplished by the natural powers alone, all the sinuses heal completely, the process of cicatrization destroys or isolates the cause of the disease, and the case is cured; usually with some permanent deformity resulting.

The special treatment to be adopted for the relief of any case of hip-joint disease depends upon and is regulated by the condition ascertained to be present after a careful examination of the case. In all cases absolute rest to the joint must be secured. All special appliances used have the accomplishment of this object in view. Recognizing the fact that there is an ever-present tendency to deformity, its prevention by every means at one's command constitutes also another item of consideration in any plan of treatment adopted.

If relief comes as a result of treatment it will not occur even in mild cases without many months, and perhaps years, of careful attention.

General and Medicinal Treatment. The general hygienic surroundings of the patient should be the best possible to obtain; abundance of fresh air and sunlight can certainly be secured, and personal cleanliness should be insisted upon. Food must be regulated according to the patient's power of assimilation—easy of digestion and rich in fats. It is the testimony of experience that all tubercular patients avoid the hydro-carbonaceous foods if allowed to have their own choice. Cod liver oil or butter administered with ale or malt are always supportive to the patient's vital powers. The dose of cod liver oil should never exceed one teaspoonful three times a day; given in larger quantities it is not absorbed and does harm. Some of the preparations of iron and the bitter tonics are found useful in many conditions of the general system accompanying the progress of the disease. The special condition of the patient will furnish the indication for their administration.

The presence of pain from any source frequently necessitates the use of some preparation of opium to subdue it; but this pain being oftenest dependent upon the pressure of the joint surfaces against each other, it will be most certainly relieved by the use of some appliance which will obviate such pressure.

During the earlier manifestations of the disease, counter-irritation over the surface of the joint by means of the application of cantharides, or heat, or cold, gives temporary relief to many of the painful symptoms accompanying its onset.

Treatment is of two kinds—conservative and operative. The conservative treatment has for its object the application of such dressings as will provide rest to the joint and at the same time overcome the already existing or prevent entirely the occurrence of the deformities which attend the disease. All of the various plans secure extension in order to keep the joint surfaces as widely separated from each other as possible, and they may be divided into portable splints and fixed apparatus. The first allows of some motion in the joint and general movement of the body, and the second secures either absolute fixation of the joint or positive confinement in the recumbent position.

The plan suggested by Hutchinson is considered by many as very efficient and particularly applicable to the treatment of the disease in its earlier stages. In it the shoe of the sound limb is raised by a sole two inches in thickness, and the patient required to use crutches; the diseased limb is thus allowed to swing free, and is prevented from coming in contact with the ground, the weight of the extremity thus acting as the extending force.

Fixation of the joint is better accomplished by the use of Thomas' splint. This consists of a band of steel a quarter of an inch thick and one inch wide and long enough to extend from the inferior angle of the scapula to a point just above the heel of the diseased limb; it is bent so as to fit accurately into all the natural curves of the body on the diseased side while the body is in the erect position. It is padded throughout its entire length and secured in position by a broad band surrounding the body, a second band surrounding the thigh, and a third one surrounding the leg towards its lower end. If now the patient is elevated by means of a thick sole on the shoe of the sound limb, and advised

to use crutches, this splint constitutes a very efficient means of fixation of the joint, the patient at the same time securing the full benefit of moderate exercise in the open air.

A third plan, adopted by many, consists in the use of some modification or other of Taylor's splint, which consists of a bar of steel made in two pieces with a ratchet attachment between them near the knee, to allow of extension. It is secured firmly at its lower end by a steel plate fastened to the sole of the shoe at its upper end, which reaches to the crest of the ilium; it is fitted to the middle of a well-padded cross bar of steel curved to correspond with the shape of the crest of the ilium. The attachment of the upper end of the splint to the cross bar is in the shape of a ball and socket joint. The extremities of the cross bar are perforated for the purpose of attachment of the perineal band, which is fitted in the crease of the perineum on the side of the diseased hip. The splint is secured to the limb by means of a well-padded band surrounding the upper part of the thigh, a second surrounding the upper part of the leg and a third fastened about the leg just above the ankle. When fastened in position along the outer side of the diseased extremity, and the perineal band in proper place, the ratchet attachment permits a considerable force of extension to be produced and at the same time allows of motion in the joint and general exercise of the body.

Thomas' splint is certainly a very satisfactory appliance to make use of for protection against injury in cases in which other treatment, which will be suggested, has led to a cessation of the manifestations of the disease, especially as a means of prevention of shock to or strain of the joint when the patient first commences to take exercise. Personally, I have had no satisfactory results follow the use of either of these appliances in anyway equal to those obtained either by the application of Buck's extension and confinement to bed, or the plaster cast and the use of crutches. Absolute fixation of the joint can be obtained by making use of the plaster cast; when used it should be so applied as to cover the entire extremity as well as the hips and body for some distance above the diseased joint. The ordinary plaster bandage, made of crinoline into the meshes of which plaster of Paris has been spread, is the best material to use. All

portions of the body covered by the plaster bandage should be thoroughly padded with cotton batting before its application, as well should the diseased limb be held in forced extension, abduction and external rotation and securely maintained in this position until the plaster has hardened. Many cases under my care have been treated satisfactorily with this appliance; deformity prevented, pain abolished and health restored.

No more efficient or satisfactory means of treatment in the majority of these cases can be instituted than that of Buck's extension. This is very simple and easily applied. It requires confinement to the bed on the back, yet I have never seen any ill effects attend its use. The most excruciating pain and the agony of night startings is almost immediately relieved after its proper application with sufficient weight. The occurrence of deformity is prevented and that already present is surely overcome. These results far outweigh the ill effects supposed to be caused by the confinement. It has been my experience, as well as that of many other surgeons, to constantly witness improvements in every way secured by the adoption of this plan of treatment. Its success is in main obtained by always making the extension in the direction of the deformity which is present. At all times during its use care should be had that the spinal column is in close contact with the bed on which the patient lies—that no lordosis is present. The shoulders also should be in contact with the bed, and the patient secured in this position by a broad bandage extending over the chest and under the arms and fastened to the bed; the head can be slightly elevated by the use of a small pillow. The bottom of the bed should be so far raised as to certainly secure the weight of the trunk as a counter extending force. Broad strips of adhesive plaster are fastened to the inner and outer sides of the diseased limb, reaching as high as the middle of the thigh and some distance below the foot; they are secured in position by the ordinary roller. The lower ends of the plaster are fastened to the ends of the usual spreader to prevent pressure on the malleoli. The rope used to carry a proper amount of weight is attached to the middle of the spreader and carried over a pulley which is already fixed in a movable upright attached to the lower end of the bed, in a direct line with the diseased extremity. The pulley should be placed at such height as to allow of the

extension being made in the direction of the existing deformity of flexion. The amount of weight used should be about one-twelfth of the entire weight of the body, and never sufficient to cause dragging pains in the groin. As the constant traction of the weight overcomes, as it surely will, muscular contraction about the hip, the pulley is lowered from time to time in accordance with the degree of improvement in the deformity of flexion until complete extension is permissible in the diseased limb without the occurrence of any lordosis.

If severe deformity of adduction be present it can be overcome by the use of the weight and pulley adjusted so as to act at a right angle with the thigh by means of a plaster band fastened around the lower end of the femur. The dressing should be kept on, or reapplied if not acting efficiently, until all pain is relieved and free motion is permissible in all directions. If the disease has progressed to any noticeable extent this result will not be secured short of one year's time.

Operative Procedures. First under the head of operative procedures are to be considered injections into the joint of a 10 per cent. emulsion of iodoform in glycerine. The iodoform treatment certainly possesses a remarkable curative effect upon tubercular degeneration in any of the joints in the body. In my hands it has proven more satisfactory in staying the progress of the disease and leading to a disappearance of the results and repair of its ravages than any other remedy or treatment that has been suggested. If the capsule is distended with fluid this should be emptied by the introduction into the joint of a good sized trocar, it being understood that the puncture is preceded by all the usual aseptic and antiseptic precautions with which you are familiar. After the fluid is emptied out through the canula, or its introduction has not been followed by the discharge of any fluid contents, from two to four drachms of the emulsion is thrown into the joint by means of a syringe and caused to be disseminated all over the joint surface by manipulation and free passive motion of the joint after the canula is withdrawn and the puncture opening protected by a pad of iodoform gauze. Some care must be used in the amount of force to which the weakened capsular ligament is subjected by the pressure of the distending emulsion for fear of rupturing this membrane followed

by the exit of the fluid into the surrounding cellular tissue. This can always be easily regulated by fastening a piece of soft rubber drainage tubing about four inches in length to the canula and fitting the syringe into the free end of it. As long as there is not much pressure upon the fluid it passes through the rubber tube without difficulty. As soon as the joint becomes over distended a well-marked bulb is formed in some portion of the length of the tube, the character of which is a sure indication as to the amount of pressure which is being made upon the capsule by the emulsion.

My experience has not shown any constitutional effects from this use of iodoform, except in one case, and that was a little boy brought afflicted with tubercular degeneration of both knee joints and one ankle joint. I injected all three joints at the same time, and this was followed by quite well marked evidences of iodoform poisoning, lasting over two days. After two injections all evidences of the disease have disappeared with the exception of deformity in the position from muscular contraction.

It has been asserted, upon good authority, that this injection is very satisfactory as well in cases in which the degeneration has gone so far as to lead to the formation of sinuses—a cure following its use without any other operative procedure. Even in cases so badly diseased as to be relegated to amputation, its use has been so satisfactory to me that I am ready to assert that no tubercular joint should be subjected to any open operation until a fair and exhaustive trial has been made of this emulsion of iodoform. It has not been found necessary to make the injection oftener than once in two weeks.

Operations: Cases are often met with presenting considerable deformity in which the surgeon is at once compelled to decide as to the advisability of forcible replacement of the limb in its normal position, especially cases in which the active processes of the disease have ceased, leaving such deformity.

Forcible replacement is not to be undertaken hastily, for the traumatism accompanying such procedure often starts the disease again with apparently increased fierceness of action. When anæsthesia proves that the fixation is neither from bony ankylosis nor severe muscular contraction, by steady and yet

quiet force the limb may be restored to its normal position. If contracture is extreme it may be necessary to practice subcutaneous division of the tendinous portions of the muscles offering greatest resistance. As soon as the limb is restored to its normal position it must be retained in that position by the application of plaster of Paris cast already described or by the use of Buck's extension. These appliances should be kept in position until all tenderness or other evidence of inflammatory action has disappeared from the joint.

In performing tenotomy about the hip-joint aseptic and antiseptic precautions should be observed, and the division of the muscles should be made through the tendinous portions, carefully avoiding all important blood vessels and nerves. Occasionally the principal obstacle to extension is produced by contracture of the fascia lata of the thigh. This fascia constitutes the main element of resistance; it should be divided by an open incision of triangular shape, the base towards Poupart's ligament and the apex towards the middle and some distance down the thigh. As the limb is extended the edges of the incision are widely separated, and this extensive wound can subsequently be closed by suturing together its lateral edges.

The formation of abscesses frequently require surgical interference, and they may either be treated by aspiration with subsequent over-distension with the iodoform emulsion already mentioned or by free open incision. If by open incision the contents are thoroughly evacuated by means of the scoop, and the cavity irrigated with a 1-3000 solution of bichloride of mercury or a solution of tincture of iodine in water strong enough to have the color of sherry and either packed with iodoform gauze to the bottom or drained with a drainage tube.

Old sinuses resulting from previous abscesses can sometimes be made to close by repeated injections of the iodoform emulsion or the injection of a 10 per cent. solution of chloride of zinc. This result is not likely to be obtained when their existence is dependent upon the presence of necrotic tissue in the diseased joint. Under such circumstances, and perhaps in the majority of cases, cure will oftenest follow the plan of laying them open freely throughout their entire length, curetting their walls, and then thoroughly scrubbing the resulting cavity with a 1-1000

solution of bichloride of mercury, after which they may either be closed by proper sutures introduced throughout the principal portion of their length to a point in close proximity to the joint, or the entire cavity packed with iodoform gauze and allowed to granulate, or closed by secondary sutures four or five days after the first operation.

Any necrotic tissue found in the joint must be removed, even to the extent of excising the remnant of the head of the bone if this is found to be totally destroyed.

In many cases the excision of the head of the bone will constitute the starting point of the operation, the full opening of the sinuses and their treatment as directed accompanying that procedure. Frequently the sinuses follow such a course in their tortuosity or depth as to endanger the large blood vessels of the thigh, thus preventing the surgeon from laying them wide open. Under such circumstances these important structures must not be injured, but the sinuses should be thoroughly curetted and rendered aseptic by the use of the antiseptic fluids recommended.

Osteotomy: Bony ankylosis following old hip-joint disease is not infrequently met with, either with the presence of sinuses or without any external openings leading to the joint, and requires for its relief a division of the bone, together with a tenotomy of the contracted muscles if these offer any resistance to the replacement of the limb in its normal position after the bone is divided.

The instruments necessary to perform an osteotomy are a scalpel and a key-hole saw or a mallet and chisel. The point of division of the bone may be either through the neck of the bone or through the shaft just below the great trochanter. If the key-hole saw is the instrument used for dividing the bone the external incision is short, only sufficiently long to admit of the easy entrance of this very narrow bladed saw. In this operation for the purpose of dividing the neck of the bone the scalpel is thrust through the soft parts just above and in front of the tip of the interior border of the great trochanter and carried firmly to the neck of the bone, all the tissues being freely divided in its course; after its withdrawal the saw is carried along the track thus made in front of the neck of the bone, which is sawed through from before backwards and the limb placed in a normal position.

When the saw is used to divide the trochanter major the scalpel is thrust through the soft parts directly down to the femur just in front of the edge of the tensor vaginae femoris muscle, and at a height corresponding with the contemplated line of section. After the bone is exposed by the incision with the knife the saw is introduced into the opening and carried in front and over the inner surface of the femur, and that bone is sawed through in a direction from within backwards and outwards. After the division of the bone the limb is placed in the position desired. An ordinary carpenter's chisel suffices for the purpose of dividing the bone in these cases. When the chisel is used to accomplish this result the point chosen for the severance of the bone is freely exposed by an incision with the scalpel through all the soft parts covering it. This incision should be long enough to allow of the introduction of the chisel through it to the bone surface, and then to permit the cutting edge of the chisel to be tured in a direction transverse to the long axis of the bone. The chisel is then driven through the bone in different directions by blows of the mallet until entirely severed or sufficiently weakened to be easily fractured by the application of slight extending force, after which the limb is carried into the position necessary to overcome the deformity and the wound closed by suture. If contracted muscles resist replacement of the limb to its normal position after any of these operations they must be subjected to subcutaneous division. All these operative procedures must be preceded, accompanied and followed by the most perfect attention to every detail of aseptic and antiseptic preparation, care and treatment of the parts operated on, of the wound and of the subsequent dressings.

Excision of the hip joint for tubercular disease thereof is an operation frequently performed and sometimes followed by lasting relief to the patient with a very useful limb. When performed very early in the manifestations of the disease before much destruction has resulted from its action, the operation is promptly recovered from and the limb possesses correspondingly greater usefulness; but even when done thus early the operation does not always secure permanent relief from the disease, for many such cases have subsequently come under my care for the treatment of tubercular abscesses, persistent sinuses re-forming

in the course of the scar, or developing in some previously unaffected portion of the joint tissues. If excision is to be followed by the longest periods of relief from disease and to secure the most useful limb, it must be done before the ravages of the disease have led to any extensive destruction of the joint elements; when done thus early the operation can be made an absolutely aseptic one, and be followed by rapid primary union of all the tissues incised with scarcely any constitutional reaction. Although many times remarkably rapid recoveries follow excision of the head of the bone, accompanied with the removal of the diseased acetabular cavity and other tubercular tissues, even after suppuration has occurred with resulting sinuses, still the probabilities of a successful and satisfactory result are greatly diminished by the presence of any such complications; the operation is far less likely to be aseptic on account of the almost insurmountable difficulties attending the purification of the sinuses and the uncertainty of complete removal of all tubercular foci. It is my belief that the persistent use of the iodoform emulsion in these bad cases will make them much more amenable to successful treatment in the future. The instruments necessary to perform excision of the hip-joint are a scalpel, probe pointed bistoury, one pair of dissecting forceps, one pair of heavy scissors, two retracting hooks, half a dozen artery forceps, a periostome, a chain saw or a straight saw with a movable back, or a chisel and mallet and needles with silk or catgut for application of ligatures or sutures. It is always well to have a Paquelin cautery ready for use in case it is desirable to destroy any tubercular tissue which cannot be otherwise removed. No better incision for exposing the joint can be made than the ordinary straight one or one made with a slight curve backwards over the situation of the trochanter major. The incision should commence at a point about two inches above the middle of the upper border of the trochanter major and terminate about an inch below the junction of the trochanter with the shaft of the femur; it should be carried with a free hand through the gluteus maximus muscle and through the periosteum of the exposed trochanter. The deeper portion of the incision should be inclined forward to correspond with the forward and inward direction of the neck of the bone; divide

the capsule of the joint and uncover the neck and head. If the disease has not made much advance, by means of the elevator the periosteum should be stripped off from the trochanter in all directions, carrying with it its muscular attachments, and in this way bring into plain view all portions of the neck, head and trochanter. In all cases it is the rule to carefully save every particle of the periosteum unaffected with tubercular degeneration, as by this means are preserved the muscular insertions and a much stronger and more useful limb insured.

In many cases the disease has so far progressed in its infiltration and destruction of the surrounding soft parts that it will be necessary to divide the muscles attached to the trochanter by means of the probe pointed bistoury in order to surely remove all the diseased tissues. It is best not to make any effort to extrude the head of the bone through the incision until after the trochanter has been perfectly freed and the capsule entirely separated by one or other of the plans just described. As soon as this is accomplished the head of the bone is readily forced through into the external incision by forcible adduction and backward pressure, using the thigh as a lever. The diseased bone is now separated from the shaft by the use of either of the saws mentioned or the chisel and mallet. My preference is given to the use of the chisel and mallet for this purpose, for with them it is possible to regulate accurately the amount of bone removed and accomplish its removal without any injury to the surrounding soft parts. In advanced cases it will usually be found necessary to include the trochanter major in the segment of the bone removed. In very early cases it may be found permissible to remove only the head and neck, and this can sometimes be done without any disturbance of the tissues attached to the trochanter major. There is considerable danger of fracturing the weakened shaft of the femur during efforts at extrusion of the head of the bone unless all of its attachments have been loosened before any such attempts are made. This fracture has occurred so often during these attempts that many surgeons advise and practice the plan of dividing the bone *in situ* without any efforts at extrusion, lifting the diseased fragment out of its bed after its severance is accomplished.

After the removal of the segment of bone the acetabulum should be examined for evidences of disease. Any granulations found present should be removed by means of the scissors or curette, and if the capsule of the joint is affected with tubercular degeneration it should be dissected away in part or in whole in accordance with the degree of degeneration present. Sometimes the destruction of manifest tubercular degeneration of the soft parts can be best accomplished by the free use of the Paquelin cautery.

If any arteries are divided during the incisions described they are temporarily controlled with the artery forceps and permanently secured by the application of ligatures.

The limb is placed in a position of extension with slight adduction and external rotation. If the case is an old one the sinuses are treated as has already been described, and the wound thoroughly irrigated with a solution of 1-2000 bichloride of mercury or the solution of tincture of iodine in water. The external wound can be treated in either of two ways. It may be packed throughout to the bottom with iodoform gauze and partially closed by a suture, or it may be closed entirely by sutures, except at the point used for the exit of large drainage tubes, introduced in such position as will provide for free outflow of the wound secretions.

If the case be a very bad one with many sinuses and much suppurative action I prefer the treatment by iodoform gauze packing, permitting the wound to heal from the bottom by granulation, or applying secondary sutures, to be tied about the fifth day, upon removing the packing.

In either case the usual external antiseptic dressings are applied and the limb maintained firmly in its normal position by the application, outside of the dressing, of the plaster cast or the use of Buck's extension. The necessity for subsequent dressings of the wound will depend entirely upon the presence of disturbance therein, as indicated by the rise in temperature—the less often disturbed the better. The external appliances for maintaining the limb in its new position should be retained for sometime after the wounds have entirely healed, and the use of the limb forbidden until all tenderness at the seat of the opera-

tion has disappeared. It is advisable to apply Buck's extension at night for at least one year after the wound is healed.

The indications for hygienic and medical treatment, such as have already been advised, should be assiduously fulfilled throughout the entire course of treatment.

Results of the Operation: After excision this extremity is always considerably shortened, and if the head, neck and trochanter have been excised the parts remaining are not such as to result in the formation of a very serviceable joint. Besides, if the destructive action be so great as to require such an extensive excision, the parts concerned are very slow in healing, and oftentimes the resulting sinuses never heal at all or remain open for years. Occasionally, owing to the continuation and extension of the disease, an unseemly deformity produces an absolutely useless limb. It is certainly a question whether the majority of limbs after excision are as serviceable to the patient as the attainment of ankylosis of the joint, with the limb in the extended position. It is even advisable to maintain extension for a year after all symptoms of acute trouble have disappeared in order to allow of complete condensation of cicatrical tissue, to diminish the degree of shortening, to avoid deformity and to provide for firm fixation of the shaft of the femur in its new position. This result can be accomplished by the use of Buck's extension with sufficient weight during the night, allowing the patient to take the usual amount of exercise during the day time.

Amputation: Cases which have been subjected to little or no treatment and which have been allowed to progress for years, with the extension of the disease to the os innominatum and shaft of the femur, and accompanied with much burrowing of pus, should be subjected to amputation of the hip-joint. With the improved methods to absolutely control hemorrhage, and the present technique of the operation, amputation for the relief of this disease is not attended with more, if as great, mortality as excision. It promises most relief because it removes the mass of the diseased tissue and allows of free and perfect drainage, and furnishes a ready method of accurate application of remedial measures to the remaining evidences of disease. Best of all an amputation puts a stop at once to the immense drain put upon

the constitutional power of the patient, resulting from an extensive suppurating cavity.

Amputation of the hip-joint will be required in some cases as a secondary measure for deformity after excision, or for the relief of such cases as are not followed by satisfactory cicatrization of the cavity left and the closure of the accompanying sinuses.

Amputation is best made after the plan of Mr. Furneaux Jordan. It consists in making a circular amputation of the thigh at a proper distance below the hip-joint. After the circular amputation is completed the blood vessels are permanently secured with ligature; the remnant of bone left is then dissected out of the stump through an incision carried from the top of the trochanter major to the end of the fragment, along its outer side.

The bleeding vessels are positively and absolutely controlled by carrying a rubber band across the perineum and over the pubis in front, and behind the trochanter and over the crest of the ilium posteriorly. The rubber is pulled as tight as possible and the ends crossed where they meet above the crest of the ilium and then carried to the opposite side of the body and securely held by an assistant. A firm pad is placed beneath the rubber across the course of the external iliac artery in such position as to actually close that vessel; it should be held securely in proper position by an assistant. Or the plan advised by Dr. Wyeth can be followed with perfect safety—pass an upholsterer's long needle through the soft tissue on the inner side of the thigh on a level with the lesser trochanter; a similar needle is carried through the tissues on the outer side of the thigh, between the trochanter major and the ilium. The needles should be long enough to project at least two inches beyond the soft parts at both ends; protect the points of both needles with a piece of cork. Encircle the thigh above the pins with a sufficient number of turns of a rubber bandage to control all the vessels. The circular amputation of the thigh is now made, first forming a skin flap which is to be turned up as far as possible; then a circular division is made of the muscles as high up as the knife can safely be carried, and the bone sawed through. All vessels are now permanently ligated, the rubber band removed and the rem-

nant of bone dissected out of the stump. No blood whatever will be lost while the rubber band remains in position, if either of the above methods are properly executed. In my experience rapid and unexpected recoveries have followed amputation of the hip-joint for bad cases of hip-joint disease.